Patent Claims

1. A protective layer for a body, which comprises at least one hard-material layer formed from metal oxide and/or metal nitride and/or metal carbide and/or metal oxynitride and/or metal carbonitride and/or metal oxycarbonitride, wherein at least one hard-material layer comprising metal oxide and/or metal nitride and/or metal carbide and/or metal oxynitride and/or metal carbonitride and/or metal oxycarbonitride is a functional layer which is interrupted by at least one interlayer formed from a metal oxide and/or metal nitride and/or metal carbide and/or metal oxynitride and/or metal carbonitride and/or metal oxycarbonitride that is different than the functional layer, and the interlayer is a layer that is very thin compared to the functional layer, the interlayer interrupting the morphology of the functional layer.

2. The protective layer as claimed in claim 1, wherein the functional layer is at least 50%, preferably more than 80%, crystalline.

3. The protective layer as claimed in claim 1 or 2, wherein the layer thickness of the functional layer is in the range from 100 to 20 000 nm, preferably between 500 and 10 000 nm and particularly preferably between 1500 and 5000 nm.

4. The protective layer as claimed in claim 3, wherein the thickness of the interlayer is ≤ 10 nm, preferably from 1 to 5 nm.

5. The protective layer as claimed in one of claims 1 to 4, wherein the functional layer is interrupted by interlayers at intervals of 30 to 500 nm, preferably at intervals of 50 to 250 nm.

6. The protective layer as claimed in one of claims 1 to 5, wherein the functional layer is interrupted by interlayers at regular intervals.

7. The protective layer as claimed in one of claims 1 to 6, wherein the functional layer which is interrupted by interlayers includes columns which on average have a lateral dimension of less than 1 μm and preferably of less than 200 nm.

8. The protective layer as claimed in one of claims 1 to 7, wherein the surface roughness has an R_a value of < 50 nm, preferably an R_a value of < 30 nm and particularly preferably an R_a value of < 20 nm.

9. The protective layer as claimed in one of claims 1 to 8, wherein the functional layer comprises silicon nitride.

10. The protective layer as claimed in one of claims 1 to 8, wherein the functional layer comprises a metal oxide.

11. The protective layer as claimed in claim 10, wherein the functional layer comprises zirconium oxide in a temperature stable crystal phase or zirconium oxide with an additional component hafnium oxide in a temperature-stable crystal phase.

12. The protective layer as claimed in claim 11, wherein an oxide selected from the group consisting of yttrium oxide, calcium oxide, magnesium oxide, tantalum oxide, niobium oxide, scandium oxide, titanium oxide or the lanthanide oxide group, such as for example lanthanum oxide or cerium oxide, is admixed to the zirconium oxide in order to stabilize the

temperature-stable crystal phase.

13. The protective layer as claimed in claim 12, wherein the hard-material layer comprising zirconium oxide contains, as stabilizing component, from 0.5 to 50 mol% of Y_2O_3, preferably from 1 to 10 mol% of Y_2O_3, and particularly preferably from 1.0 to 7.5 mol% of Y_2O_3.

14. The protective layer as claimed in one of claims 11 to 13, wherein the interlayer comprises zirconium nitride.

15. The protective layer as claimed in one of claims 1 to 14, wherein the interlayer comprises silicon oxide.

16. The protective layer as claimed in one of claims 1 to 14, wherein the interlayer comprises titanium-aluminum oxide.

17. The protective layer as claimed in claim 16, wherein the refractive index n of the interlayer can be set in a range from $1.55 \leq n \leq 2.50$ by means of the ratio of aluminum to titanium.

18. The protective layer as claimed in one of claims 2 to 18, wherein the interlayer is at least 50%, preferably more than 80%, amorphous.

19. The protective layer as claimed in one of claims 1 to 18, which also has a further hard-material layer, in particular a transparent hard-material layer.

20. The protective layer as claimed in claim 17, wherein the further hard-material layer comprises at least 50% silicon oxide.

21. A protective layer for a body, which comprises at least

one hard-material layer formed from metal oxide and/or metal nitride and/or metal carbide and/or metal oxynitride and/or metal carbonitride and/or metal oxycarbonitride, wherein at least one hard-material layer comprising metal oxide and/or metal nitride and/or metal carbide and/or metal oxynitride and/or metal carbonitride and/or metal oxycarbonitride is a functional layer which grows in the form of predominantly crystalline, columnar structures and which is interrupted by very thin interlayers, preferably with a thickness of less than 10 nm, at intervals of 30 to 500 nm, so that the functional layer has laterally tightly cohesive, crystalline columns which grow perpendicular to the surface of the body and which, in columnar growth, have little tendency to widen out, and preferably have a mean lateral dimension of less 1 μm and particularly preferably of less than 200 nm.

22. The protective layer as claimed in one of claims 1 to 21, which is distinguished by its use for coating bodies made from glass, glass-ceramic or other non-metallic, crystalline materials.

23. A cooking hob, which has a coating which includes a protective layer as claimed in one of claims 1 to 22.

24. A cooking device, which has a coating which includes a protective layer as claimed in one of claims 1 to 22.

25. A process for coating a body with a protective layer, in particular with a protective layer as claimed in claims 1 to 22, comprising the steps of:

a) providing the body and the layer substances in a vacuum system,

b) coating the body by means of a reactive physical vapor deposition process, producing layer substances in atomic dimensions which as a functional layer grow in columnar

structures substantially perpendicular to the body surface on the body,

wherein

b1) the growth of a functional layer is interrupted at least once by the deposition of a very thin interlayer which, uninfluenced by the functional layer that has already grown, has a different morphology, so that the tendency of columnar structures to widen out in the functional layer is interrupted.

26. A process for coating a body made from glass, glass-ceramic or another nonmetallic, crystalline material, in particular for coating a glass-ceramic hotplate, with a protective layer, in particular with a protective layer as claimed in claims 1 to 20, comprising the steps of:

a) providing the body and the layer substances in a vacuum system,

b) coating the body by means of a reactive physical vapor deposition process, producing layer substances in atomic dimensions which, as functional layer, grow in columnar structures substantially perpendicular the body surface on the body,

wherein

a1) the body which is to be coated, made from glass, glass-ceramic or another nonmetallic, crystalline material is transferred into the vacuum system in order to be coated immediately after it has been produced, and

b1) the growth of a functional layer is interrupted at least once by the deposition of a very thin interlayer which, uninfluenced by the functional layer that has already grown, has a different morphology, so that the tendency of columnar structures to widen out in the functional layer is interrupted.

27. The process as claimed in claim 25 or 26, wherein the body is coated by electron beam vaporization assisted by ion beam.

28. The process as claimed in claim 27, wherein the energy of the ions of the assisting ion beam is between 1 and 2500 eV, preferably 1 - 800 eV, and particularly preferably between 20 and 450 eV.

29. The process as claimed in claim 25 or 26, wherein the body is coated by magnetron sputtering.

30. The process as claimed in one of claims 25 to 29, in particular for coating a body with a protective layer as claimed in claims 10 to 20, wherein the layer substances are in solid form, as metallic components or as metal oxides.

31. The process as claimed in claim 30, wherein oxygen is fed into the vacuum system during the growth of the functional layer.

32. The process as claimed in claim 30 or 31, wherein at least one additional gas, preferably nitrogen, for optimizing the material-removal rate and optimizing the formation of atomic oxygen is fed into the vacuum system during the production of the layer substances.

33. The process as claimed in one of claims 30 to 32, wherein the coating of the body comprises a thermal aftertreatment, preferably in an oxygen atmosphere.

34. The process as claimed in claim 33, wherein the thermal aftertreatment is carried out at temperatures of up to 800°C, preferably at temperatures of between 400°C and 700°C.

35. The process as claimed in one of claims 25, 27 to 34, wherein the surface of the body to be coated is subjected to a cleaning operation before it is coated.

36. The process as claimed in claim 35, wherein the cleaning is carried out in a vacuum chamber by plasma treatment with ions, the energy of which is preferably in the range from 1 to 2500 eV, with preference from 50 to 1600 eV, and particularly preferably from 100 to 500 eV.

37. The process as claimed in one of claims 25 to 36, wherein the surface of the body to be coated is activated before being coated.

38. The process as claimed in claim 37, wherein the activation is carried out in a vacuum chamber by means of a plasma treatment with ions, the energy of which is preferably in the range from 1 to 2500 eV, preferably from 50 to 1600 eV, and particularly preferably from 100 to 500 eV.

39. The process as claimed in claims 36 and 38, wherein the cleaning and activation are carried out in a single process step.

40. The process as claimed in one of claims 25 to 39, wherein the body to be coated, at least before the layer substances are deposited, is heated to process temperatures of up to 800°C, and preferably of between 50°C and 550°C, particularly preferably between 100°C and 350°C.

41. The process as claimed in one of claims 27 to 40, wherein the coating operation comprises the polishing of the surface of the applied layer in at least one polishing step.

42. An arrangement for coating a body made from glass, glass-ceramic or another nonmetallic, crystalline material, in particular for coating a glass-ceramic hotplate, with a protective layer, in particular with a protective layer as claimed in claims 1 to 17, comprising a coating installation, which has at least one coating chamber (4.n), the coating chamber (4.n) being a vacuum chamber and the coating chamber having targets comprising the layer starting materials, excitation sources for generating layer starting materials in atomic dimensions, at least one process gas inlet valve (15) for feeding process gases into the coating chamber (4.n), and shutters (7) for feeding and discharging the substrate (8) to be coated into and out of the coating chamber (4.n), wherein the coating installation is directly connected, via a substrate transfer station (2.1) and an input lock (2.2), to the production installation (1) for the substrate (8) which is to be coated.

43. The arrangement as claimed in claim 42, wherein the excitation sources are vaporization sources.

44. The arrangement as claimed in claim 42, wherein the excitation sources are magnetron sputtering sources (13), in particular with pulsed magnetrons.

45. The arrangement as claimed in claim 42 or 44, wherein the excitation sources are double magnetrons.

46. The arrangement as claimed in one of claims 42 to 45, wherein the coating installation has a cleaning/activation chamber (3), the cleaning/activation chamber (3) being a vacuum chamber and having at least one cleaning/activation ion beam source (11) for cleaning and/or activating the substrate (8), and/or the coating installation including an

apparatus which can be used to ignite a glow discharge, being arranged between the input lock (2.2) and the coating chamber (4.1) and being connected to them via shutters (7).

47. The arrangement as claimed in one of claims 42 to 46, wherein the coating installation has further coating chambers (4.n), where n > 1, as a function of the number n of layer starting materials.

48. The arrangement as claimed in one of claims 42 to 47, wherein the coating installation has an aftertreatment chamber (5), the aftertreatment chamber (5) being a vacuum chamber and including at least one oxygen feed valve (16) and heating elements (9) and being connected, via a shutter (7), to the coating chamber (4.1) or a further coating chamber (4.n).

49. The arrangement as claimed in one of claims 42 to 47, wherein the coating chamber (4.n) and the cleaning/activation chamber (3) have heating elements (9) for setting the coating temperature.